

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently Amended) An end effector adapted to grip a peripheral edge of a workpiece, comprising:

a workpiece blade for supporting a workpiece;

a first gripper arm ~~and a second gripper arm each~~ operatively mounted to said workpiece blade, said first ~~and second gripper arms each~~ arm including a first contact pad and first load sensing device for generating electrical signals representing the amount of force said first contact pad is exerting on the workpiece;

a second gripper arm operatively mounted to said workpiece blade, said second gripper arm having a second contact pad and a second load sensing device for generating electrical signals representing the amount of force said second contact pad is exerting on the workpiece;

a motor assembly for moving said first and second gripper arms between a workpiece-loading position and a workpiece-engaging position, ~~said contact pads contacting the peripheral edge of the workpiece and exerting a force on the workpiece when said first and second gripper arms are located in said workpiece-engaging position; and~~

~~a real-time force feedback system for generating an electrical signal representing the amount of force said contact pads exert on the peripheral edge of the wafer and sending said electrical signal to said motor assembly for dynamically adjusting the force exerted by said contact pads on the workpiece while said first and second gripper arms are located in said workpiece-engaging position.~~

a processor for receiving sending said electrical signal signals from said first load sensing device and said second load sensing device and controlling the drive current supplied to said motor assembly, enabling said processor to continually adjust for dynamically adjusting the force exerted by said first contact pad and said second contact pads pad exerts on the workpiece while said first and second gripper arms are located in said

~~workpiece-engaging position.~~

2. (Previously Cancelled)
3. (Cancel)
4. (Currently Amended) The end effector according to claim 1, wherein said first and second contact pads further include sensors adapted to detect the edge of the workpiece.
5. (Original) The end effector according to claim 4, wherein said sensors comprise thru-beam sensors.
6. (Previously Cancel)
7. (Currently Amended) An end effector adapted to grip a peripheral edge of a workpiece, comprising:

a workpiece blade for supporting a workpiece;

a first gripper arm and a second gripper arm each operatively mounted to said workpiece blade, said first and second gripper arms each including a contact pad;

a motor assembly for moving said first and second gripper arms between a workpiece-loading position and a workpiece-engaging position, said contact pads contacting the peripheral edge of the workpiece and exerting a force on the workpiece when said first and second gripper arms are located in said workpiece-engaging position, said motor assembly including:

a ~~brushless~~ motor having an output shaft;

~~a planetary gear having a first end coupled to said output shaft and a second end having a shaft extending outward from said planetary gear that rotates slower than said output shaft;~~

a cam coupled to said output shaft, said cam having a geometrical center that is offset from the rotational center of said output shaft;

a carriage having a drive slot adapted to receive said cam; and

~~a flexible link having a central portion adapted to secure to said carriage, a first and end adapted to secure to said first gripper arm, and a second end adapted~~

~~to secure to said second gripper arm.~~

a real-time force feedback system for generating an electrical signal representing the amount of force said contact pads exert on the peripheral edge of the wafer and ~~sending~~ controlling said electrical signal supplied to said motor assembly for dynamically adjusting the force exerted by said contact pads on the workpiece while said first and second gripper arms are located in said workpiece-engaging position.

8. (Currently Amended) The end effector according to claim 7, wherein said real-time force feedback system comprises:

a force sensing device coupled ~~secured~~ to each one of said contact pads, each force sensing device adapted to generate an electrical signal representing the amount of force said contact pad exerts ~~being exerted~~ against the workpiece; and

a processor for receiving ~~adapted to receive~~ said electrical signal from each said force sensing device and controlling the drive current supplied ~~sending an electrical signal~~ to said ~~brushless~~ motor so that said motor may ~~in order to~~ adjust the position of said first and second gripper arms.

9-16. (Previously Cancelled)

17. (Currently Amended) An apparatus for handling wafers, comprising:

a wafer blade for supporting a wafer;

a first contact arm and a second contact arm each operatively mounted to said wafer blade, said first and second contact arms each having a contact pad adapted to contact a peripheral edge of the wafer;

a motor assembly operatively connected to said first and second contact arms, said motor assembly for moving said first and second contact arms between a wafer-loading position that allows a wafer to be loaded onto said wafer blade and a wafer-engaging position where each said contact pad contacts the peripheral edge of the wafer ~~and exerts a force on the wafer~~;

a force sensing device coupled to each one of said contact pads, each force sensing device adapted to generate ~~an electrical signal~~ signals representing the amount of force ~~being~~

~~exerted by~~ said contact pad is exerting against the peripheral edge of the workpiece;
and

a processor for receiving ~~adapted to receive~~ said electrical ~~signal~~ signals from each said force sensing device and controlling the drive current supplied ~~sending an electrical signal~~ to said motor assembly ~~in order to~~ such that said processor maintains said electrical signals received from said force sensing devices at a substantially constant level. ~~dynamically adjust the position of said first and second contact arms while said first and second contact arms are in contact with the peripheral edge of the wafer.~~

18. (Currently Amended) The apparatus according to claim 17, wherein each said force sensing device measures the force said contact pad exerts ~~pads exert~~ on the wafer in real-time.

19. (Previously Presented) The apparatus according to claim 17, wherein each said contact pad further includes a sensor ~~sensors~~ adapted to detect the edge of the wafer.

20. (Currently Amended) The apparatus according to claim 17, wherein each said force sensing device comprises a load cell.

21. (Original) The apparatus according to claim 17, wherein said force sensing device comprises a strain gauge.

22-35. (Previously Cancelled)

36. (New) The end effector according to claim 1, wherein said first and second load sensing devices comprises a load cell.

37. (New) The end effector according to claim 1, wherein said first and second load sensing devices comprises a strain gauge.

38. (New) The end effector according to claim 1, wherein said workpiece blade includes a proximal end and a distal end.

39. (New) The end effector according to claim 38, wherein said first gripper arm and said second gripper arm each include a proximal end and a distal end, said proximal end of said first gripper arm and said second gripper arm are each rotatably connected to said proximal end of said workpiece blade.

40. (New) The end effector according to claim 38, wherein said distal end of said workpiece

blade comprises a first finger and a second finger.

41. (New) The end effector according to claim 40, wherein said first finger and said second finger each include a workpiece support pad.